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Via Overnight Federal Express

The Honorable David Small
Secretary, Department of Natural Resources and Environmental Control
Richardson & Robbins Building
89 Kings Hwy
Dover, DE 19901

Re: Bloom Energy

Dear Secretary Small:

Thank you for the opportunity to expand upon the discussions of January 22, 2015, between you and your staff and representatives of Bloom Energy (Bloom or the Company). Specifically, we discussed the application of the Manufacturing Process Unit (MPU) exemption, and other Resource Conservation and Recovery Act (RCRA) and Delaware Hazardous Waste Management law exemptions and qualifications, to the desulfurization canister units (Desulf Units) which are a component of Bloom Energy servers used to make electricity.[1] This letter and accompanying materials provide support for Bloom Energy's conclusion that **the contents of the Desulf Units are regulated as waste no earlier than when the Units are opened** for maintenance and replacement and/or recycling of the residue they contain. Neither the U.S. Environmental Protection Agency (EPA) nor any State has ever taken a position contrary to this conclusion.

[1] This letter makes frequent references to the federal Resource Conservation and Recovery Act and regulations adopted thereunder. In all respects material to this letter, the federal provisions were adopted verbatim by Delaware in the implementation of the Delaware Hazardous Waste Management law, 7 Del. Code Chapter 63, and particularly the regulations thereunder. Since June 22, 1984, Delaware has had delegated primary responsibility for implementing the RCRA hazardous waste program within the State. The legal arguments contained in this letter have been reviewed and are joined in by Bloom Energy's Delaware counsel.

Several questions you and your staff raised during and subsequent to our January meeting, that do not bear directly on the application of the MPU exemption, have been and/or will be answered in separate communications.

Bloom Energy Servers™ (Servers) (pictured in Enclosure 1) are sited at and provide power to federal and state facilities, as well as to private sector facilities in more than 200 locations across 11 states. Moreover, as will be set out in more detail in this letter, once Bloom's Desulf Units are removed from operation in Delaware, as in other states, they are promptly moved to facilities in Texas, where they are opened, emptied, cleaned and refilled before being returned to Bloom to be reused.[2] We believe that, with the further information and analysis provided in this letter, DNREC will conclude that removal of the Desulf Units from service does not constitute generation of a waste unless and until the Desulf Units are opened, provided this occurs within 90 days of removal from service.

I. Introduction to Bloom Energy

Bloom Energy was founded in 2001, in Sunnyvale, California, by Dr. K.R. Sridhar, who has graduate degrees in nuclear engineering and mechanical engineering, and who spent many years working with NASA developing a technology to convert atmospheric gases on Mars to oxygen usable for propulsion and life support. In connection with this work, Dr. Sridhar built a fuel cell that uses electricity generated by a solar panel to produce air and fuel. After concluding his work for NASA, Dr. Sridhar decided to apply his expertise to our own planet—developing a technology for producing clean, reliable, affordable electricity here on earth, with minimal impact on the environment. This is Bloom Energy.

Bloom's Servers produce electricity using an innovative solid oxide fuel cell technology created by Dr. Sridhar and his colleagues at Bloom, to convert natural gas or biogas into electricity. The result is among the most efficient electricity generators available, with significantly reduced greenhouse gas and criteria pollutant emissions.

Starting with its first Servers installed commercially in 2008, Bloom's Servers now produce electricity at more than 200 customer sites, ranging from commercial customers (i.e., Apple, eBay and Verizon), utilities (Delmarva Power, Pacific Gas & Electric) and universities (Caltech), to government facilities (New York City Hall, NASA, and strategic Department of Defense facilities).[3]

In May of 2013, Delaware became an important center of Bloom Energy's manufacturing operations when the Bloom Energy Manufacturing Center opened in Newark to complement Bloom's facilities in Sunnyvale, California. As Bloom's founder and CEO, Dr. Sridhar, explained during the inauguration of the Delaware Manufacturing Center, Bloom's on-site

[2] In the past, refilling operations were handled at the Texas facilities, but Bloom is currently transitioning the refilling of all empty canisters to Delaware.

[3] Bloom Energy anticipates introducing a smaller Server for residential use in the US. These will use the technology, including the desulfurization process, described in this letter.

power generation systems manufactured in Delaware produce clean, reliable electricity, using a highly efficient and environmentally superior non-combustion process.

The Bloom Energy process generates electricity with a substantially reduced environmental footprint compared to traditional energy sources.

- Reduced GHG Emissions: Bloom's Servers convert natural gas or biogas into electricity through an electrochemical reaction without combustion. The result is a dramatically lower air emission profile in comparison to combustion-based power generation. The Servers can generate electricity starting at above 60% efficiency (lower heating value of gas to A/C power), representing an approximately 50% reduction in carbon dioxide in comparison to the US grid.[4] When operating on biogas derived from waste streams, the Servers generate carbon neutral electricity. Additionally, as a distributed resource, Bloom Energy Servers avoid the losses associated with the transmission and distribution of electricity from centralized resources, representing an additional 6%+ increase in efficiency in comparison to the US Grid.[5]

- Reduced Criteria Pollutants: By virtue of the non-combustion process, Bloom's Servers virtually eliminate NOx, SOx, CO, VOCs, and particulate matter emissions from the energy production process. Thus, Bloom Energy Servers can be strategically sited into dense areas of the grid without impacts to public health that would come with some other distributed power sources.

- Reduced Water Use: The Servers consume no water during normal operation, as compared to thermoelectric plants, which make up 49% of water withdrawals in the US.[6]

- Improved Water Quality: The Servers do not discharge any water, eliminating the threat posed by other technologies to water supplies, aquatic ecosystems, fisheries and health.

- Reduced Land Use and Noise Impact: The Servers require little space and produce very little noise.[7]

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[4] http://www.epa.gov/cleanenergy/documents/egridzips/eGRID_9th_edition_V1-_year_2010_Summary_Tables.pdf.
[5] http://www.epa.gov/cleanenergy/documents/egridzips/eGRID_9th_edition_V1-_year_2010_Summary_Tables.pdf.
[6] http://pubs.usgs.gov/circ/1344/pdf/c1344.pdf.

- Unobtrusive Installation: The installation of a Bloom Energy Server involves only the construction of a concrete pad and interconnects to the electric grid, gas supply, and the internet. As a result, siting impacts are minimal, without disruption of wetlands, streams, forests or aesthetics.

- Replaces Diesel-Powered Generators: The Servers are increasingly relied on to provide reliable power to schools, hospitals, public safety facilities and other users who cannot afford to lose power. Using these Servers eliminates the need for diesel-powered generators and the associated exposures to harmful diesel exhaust, thus providing a significant public health benefit, which is especially important for the sensitive populations (children, the elderly and the sick) most affected by diesel exhaust emissions.

The Bloom Energy system's environmental benefits have been recognized by numerous organizations and individuals committed to protection of the environment. Among others, the Environmental Defense Fund has highlighted the role Bloom will play in the drive towards a sustainable future: "This kind of technology is a win-win economically and environmentally, one from which all sectors stand to benefit" (Jim Marston, EDF vice president for energy programs).[8] Carl Pope, former chairman and executive director of the Sierra Club, praised Bloom stating: "This fuel-cell technology could make obsolete the need to back up grid power with batteries or generators—a requirement for hospitals, data centers, public-safety facilities, and other facilities that can't afford a power outage."[9] And Thomas Friedman wrote about Bloom's founder, Dr. K.R. Sridhar, "A more gentle and thoughtful soul on the issues of energy and environment does not exist."[10]

Bloom Energy is grateful for the recognition it receives from these and other environmental leaders. At Bloom, protecting and improving the environment, and compliance with environmental laws, are core principles of our business.

II. Bloom Energy's Desulf Units.

A. The Function of Desulf Units.

Bloom Energy produces electricity primarily from natural gas.[11] Because natural gas is odorless, virtually all gas suppliers in the United States add sulfur compounds to their natural

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[7] The Servers' power density is greater than 1kW/ft^2 and can fit within a few parking spaces; the Servers produce less than 70 decibels of noise at six feet.
[8] www.edf.org/energy/innovation/fuel-cell-technology.
[9] www.huffingtonpost.com/carl-pope/tis-the-gift-to-be-simple_b_628219.html.
[10] Friedman, Thomas, Hot, Flat and Crowded: Why We Need a Green Revolution, page 419.
[11] Bloom Energy also uses renewable biogas in some Servers, and these Servers also use the Desulf Units to prevent any sulfur from reaching the fuel cell.

gas as a safety precaution, allowing those in the vicinity to smell the gas in the event there is a pipeline leak. The sulfur compounds, however, impede the function of the fuel cell. Accordingly, once the natural gas enters the Server, desulfurization is one of the first steps in Bloom's process of producing electricity. This step occurs in Desulf Units—typically three identical units—through which the natural gas passes.[12] The Desulf Units are filled with adsorbent materials ("filters") to remove sulfur compounds from the natural gas. Without these Desulf Units, Bloom could not manufacture electricity. If the sulfur is not filtered out appropriately, and passes into the fuel cell component of the Server, the fuel cell system experiences a decline in efficiency and ultimately, the fuel cells themselves will become permanently damaged, and electricity generation will cease.

B. Bloom Energy's Desulf Units Have Structural Integrity and Are Engineered Such That There Can Be No Releases Before They Are Intentionally Opened.

Bloom Energy engineers and builds its Desulf Units to meet exacting specifications to assure that they have structural integrity during operation, while they are out of service for cleaning and maintenance, and for many years of continued operation when returned to service. Because of the potential dangers from natural gas releases, the integrity of the Desulf Units is critical to assuring there will be no releases of natural gas. In fact, the exacting design specifications for the Desulf Units have proved effective. As explained in more detail below, Bloom has an extensive system for detecting any leaks in the Units. In the seven years that the Desulf Units have been in operation, and have been returned to operation after removal of the filters, there has never been a release or leak of natural gas detected from any Unit—whether in operation or out of operation—in Delaware or anywhere else.

The Server is constructed so that if there were a leak from the Desulf Unit or anywhere else in the Server, the system would immediately shut down—no natural gas would flow into or through the Server. Thus, the structural integrity of the Desulf Unit is essential to prevent any releases of gases to the atmosphere, to ensure the safety of customers and their neighbors, and to Bloom Energy's business operation—its ability to produce electricity.

The Desulf Units are built to last for the life of the Server (15+ years) and beyond. The Desulf Units themselves are made of extruded aluminum or zinc-plated steel, with a wall thickness of approximately 5 millimeters. This is more than 5 times the thickness of the steel used in DOT drums certified for shipping hazardous materials.

One fact of particular importance to the issues at hand is that the Desulf Units cannot be opened without special equipment and instructions. The bolts on the top of the Desulf Units

[12] Each server typically contains a fourth back-up Unit which is available, but not operational, except (1) in the event of a malfunction in one of the three operational Desulf Units, or (2) to transition during the process of replacing the three operational Desulf Units being removed for maintenance.

are torqued to 24 foot pounds, and the bottom bolts are torqued to 15 foot pounds to ensure tightness and prevent releases. The 8 bolts (+1 eye bolt) on the top and the 9 bolts on the bottom are closed using a precise (and not discernible) torque sequence, as illustrated in the enclosed page of instructions. See Enclosure 2. This unique closure sequence distributes the loading evenly across the surface as individual screws are tightened to the specific torque, similar to a lug nut tightening pattern used for car wheels. As a result, the Desulf Units are sealed, until purposely opened, in a secure manner. After closure, the Unit gaskets are subjected to multiple pressure tests, further ensuring that no accidental opening or release can occur. These tests include: a bottom gasket pressure test (23-35 pounds per square inch (psi)); a whole Unit 60 minute soak test (24 psi, to validate that there are no leaks found after 60 minutes); and immediately following the 60 minute soak test, a 20 minute decay test (22.5 psi, to validate no pressure loss over the 20 minute period).

C. Removal and Management of the Desulf Units for Cleaning and Maintenance.

Approximately every six to twelve months, Bloom Energy removes the Desulf Units from service in order to remove the filters, replace them with fresh filters, and return the Units to service. Before they are removed from service, the Desulf Units are purged of natural gas, with the gas being sent on through the remaining components of the server to generate electricity. Because the Units are removed from service while the filters are still able to function to remove sulfur, there is flexibility in the exact timing of removal. Typically, Bloom will remove the Desulf Units from service to coincide with scheduled pick up for transportation to the facilities in Texas at which they are opened and the contents removed.

When a Desulf Unit is removed from service, a self-sealing mechanism automatically seals shut the piping manifolds through which natural gas passes through the unit. This automatic valve closure feature ensures that (1) contents cannot leak or escape until the unit is opened to remove the contents, and (2) human error in execution cannot lead to gas release. The Desulf Units are removed from service long before the filters are spent, but after they have begun to experience—or are expected to experience—a gradual decline that would, if it continued over several months, threaten the performance of the Server's fuel cells.

Once removed from service, the Desulf Units are promptly sent to a licensed transfer facility in Texas that: (1) opens the unit and removes the filter, with removal performed by technicians who have received training from Bloom; (2) reclaims or arranges for reclamation of copper from the filters; and (3) collects the post-reclamation filter residue and ships it to a licensed Treatment, Storage and Disposal Facility (TSDF).[13] There is no other material in the filter, or left as residue inside the units, that raises any RCRA or other waste concerns.

[13] In December of 2014, DNREC staff wrote to Bloom Energy questioning the application of the MPU exemption to the Desulf Units. In response, Bloom Energy has managed the Desulf Units in Delaware as

Once the filter is removed from the Desulf Units, the Units are cleaned and returned to Bloom Energy to be refilled and reused.[14] It is an economic necessity for Bloom that the Desulf Units be properly managed such that they are out of service for the shortest possible period and can be promptly returned to service in another Server.

The Desulf Units themselves are valuable in several respects which require that Bloom account for them and assure that none "go missing." They are expensive to manufacture—the materials alone cost several thousand dollars, even without taking the additional shipping and labor costs into account. They represent a reusable technology that is integral to the Bloom Energy business operation which requires a seamless supply chain of Desulf Units to support continuous operation of its Servers at client sites. And, finally, the filters themselves contain copper—up to 30% of one of the filter materials—which is generally reclaimed and has value. The reuse of Desulf Unit materials, as well as the canisters themselves, is in keeping with the Bloom "cradle-to-cradle" culture, where we have a zero-waste objective, and do not discard anything we can reuse.

D. Only a Small Proportion of the Desulf Units Test RCRA Hazardous.

As is apparent from the fact that filters are shipped from the transfer facility to a licensed TSDF, Bloom has managed the filters as hazardous wastes once the Desulf Units are opened and emptied and/or reclaimed. That is because, although the filters' sole purpose is to adsorb non-RCRA hazardous sulfur from the natural gas, the filter may also adsorb a small amount of the benzene that is typically present in natural gas.

Bloom Energy tested Desulf Unit filters from each of the four Delaware sites. The results at all four sites are non-hazardous for RCRA metals and at three of the four sites the filters were below the RCRA toxicity characteristic for benzene.[15] Only at one of the four sites in Delaware did the Desulf Units test above the RCRA benzene limit. (Given the high proportion of filters that are not RCRA hazardous, the Company is developing a plan for testing the material, once it is removed from the Desulf Units, so that materials that are non-hazardous could be managed accordingly, if necessary.)

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hazardous waste from the time they are removed from service, pending resolution of the issues addressed in this letter. This letter describes the process that was used before December 9, 2014 in Delaware and continues to be followed in the other states in which Bloom Energy does business.

[14] *See* fn 2 above.

[15] Enclosure 3 is the report on the January 21, 2015 test results. Please see pages 7-10 for the metals and volatile organic compounds (VOCs) results from the four Delaware sites.

III. Applicability of Hazardous Waste Laws and Regulations

As described above, in a few instances the filters in the Desulf Units adsorb a sufficient amount of benzene to exceed the RCRA benzene limit. However, for RCRA's hazardous waste regulations to apply to the filters, they must be both (1) hazardous and (2) a solid waste. Bloom believes that the filters are not subject to hazardous waste regulations at any point before the Desulf Units are opened for the purpose of removing the filters.[16]

A. The Desulf Units Fall Squarely Within the Plain Language of the MPU Exemption.

From the outset of Bloom's commercial operations, it has understood its Desulf Units to be MPUs, which are exempt from regulation as hazardous waste until they are opened and the contents removed.

This exemption was first adopted by EPA and subsequently adopted by Delaware. Both Delaware law and the RCRA regulations provide, in identical language:

> Hazardous wastes which are exempted from certain regulations. A hazardous waste which is generated in a product or raw material storage tank, a product or raw material transport vehicle or vessel, a product or raw material pipeline, ***or in a manufacturing process unit ..., is not subject to regulation [as a hazardous waste] until it exits the unit in which it was generated***....unless the hazardous waste remains in the unit more than 90 days after the unit ceases to be operated for manufacturing. . . .

40 CFR 261.4(c) (emphasis added); Adopted verbatim at Delaware Hazardous Waste Regulations (Delaware Regulations) Section 261.4(c).

B. The Desulf Units Fit the Explanation and Description of MPUs in the Preamble Accompanying Adoption of the MPU Exemption by EPA.

The MPU exemption contains a clear statement of the rationale for the exemption:

> [T]he rationale for exempting hazardous waste from regulation while it remains in the unit within which it was generated is

[16] Even at that point, the copper in the filters is often reclaimed, such that waste is not generated until the reclamation process is complete. 40 CFR 261.1(c) (3) and (4); Delaware Regulations Section 261.1(c) (3) and (4).

> that ***the unit will have structural integrity against releases and will be operated to prevent such releases***.

45 Fed. Reg. 72025 (emphasis added).

Structural Integrity. As explained in further detail above, the Desulf Units have exceptional structural integrity. They are made from extruded aluminum or zinc-plated steel with a wall thickness that is *5 times greater than what is required by DOT* for containers shipping hazardous materials and wastes. Their structure and their engineering (including self-closure mechanisms and barriers to unauthorized opening) guard against any potential accidental releases prior to intentional, authorized opening of the Desulf Units. These units *must* be extremely durable and secure because they are designed to contain natural gas under pressure, and to be used and reused for that purpose many times over. Indeed, as discussed above, Bloom subjects each Desulf Unit upon closure to three separate pressure tests to confirm that the Units are tightly sealed. Moreover, as further confirmation of the structural integrity of the Desulf Units, Bloom had the Units tested by a DOT certified testing agency. The Bloom Unit passed all DOT testing requirements – drop test, stacking test and vibration test – for steel, aluminum or other metal containers used to ship hazardous materials.[17] In sum, these Units clearly "have structural integrity against releases" and are "operated to prevent such releases"—the characteristics which EPA concluded made it appropriate to remove containers from regulation as solid wastes.

EPA further states that most MPUs are units that:

> are designed and operated to hold valuable products or raw materials in storage or transportation or during manufacturing. **Because of their design and operation, these units are capable of holding… the hazardous wastes which are generated within them, until the wastes are purposefully removed**. Thus, these **hazardous wastes are contained against release** into the environment… and the **risks they pose to human health or the environment are very low** and are **only incidental to the risks posed by the valuable product** or raw material with which they are associated....
>
> Except where the unit…is not operating, as discussed below, the Agency believes that the **hazardous waste generated in such a unit should only be subject to regulation when it is**

[17] This testing was prompted in part by questions posed by DNREC, during our meeting, regarding whether transportation would affect the integrity of the Units. We believe that these results should resolve any remaining concerns in that regard.

> **removed from the unit**. In most cases, it is **only after the removal** of hazardous wastes from these units **that the wastes have the potential for releasing hazardous constituents** into the environment and posing a substantial hazard to human health or the environment....

45 Fed. Reg. 72025 (emphasis added).

This rationale applies fully to Bloom's Desulf Units, which are specifically designed and operated to be capable of holding the valuable raw material—natural gas—that passes through them, as well as the copper-rich filter media through which the gas passes. They have strong structural integrity. If the Desulf Units were to leak, the system would shut down, and the Server would fail to produce electricity. Detectors within the Server are in place to detect *any* gas leaks; under that scenario, these would shut down the manufacturing process and prevent negative impact.

This exceptional leak detection system makes it unnecessary to speculate about the integrity of the Desulf Units. The fact is that in the seven years that Bloom has operated its Servers, there has not been a single release of natural gas detected from the Desulf Units. Bloom's Desulf Units are made to last, and are built to be used and reused for many years without leaks or releases.

90-Day Limitation. RCRA regulations contemplate that the rationale behind the MPU exemption does not apply indefinitely. Given the prerequisite that these units have structural integrity in operation, EPA concluded that one could reasonably assume such integrity would remain intact for 90 days after the exempted units were removed from service.

> EPA recognizes that manufacturing units ... are occasionally taken out of operation for temporary periods ... [for] business reasons [or] for maintenance or repair.... For both temporary and permanent shutdowns, the Agency will allow a reasonable time to remove any hazardous wastes that remain in the unit after operation ceases. **Given the presumption that the unit has integrity before cessation of operation, the Agency believes that a reasonable time is 90 days....** If hazardous wastes remain in these units more than 90 days after cessation of operation, EPA believes that these wastes should be fully regulated....

45 Fed. Reg. 72025 (emphasis added).

Accordingly, only two events after removal of an MPU from service can trigger a requirement to manage hazardous wastes according to RCRA requirements:

(1) removal of the waste from the MPU; or
(2) passage of 90 days after removal from service.

While the Preamble contemplates taking MPUs out of service for maintenance purposes, it does not specify that this maintenance must take place on site. Bloom Energy removes the Desulf Units for maintenance purposes and sends them off-site for opening, removal of used filters, and refilling with new filters. The Units are removed from various Servers in geographic proximity to each other at approximately the same time, so that Units to be replaced can be removed for maintenance in a single shipment and the replacement Desulf Units can be delivered in a single shipment. This is a process that takes days, not months, because of the need to rotate the units back into operation. [18]

C. The Desulf Units Are Analogous to the Tanks Referenced in the Federal Register Preamble.

The MPU exemption is contained within a broader regulation that also exempts hazardous wastes generated within storage tanks and transport vehicles and vessels. EPA's Preamble cites to sludges and residues produced in tank trucks, rail tank cars, and tanks or holds of ships, which must periodically be removed through washing. 42 Fed. Reg. 72025. It also cites to sludges and sediments that are produced in tanks that store crude oil and refined petroleum products such as gasoline, which must also be removed periodically.

In the respects relevant here, Desulf Units, EPA's rationale for exempting hazardous waste sludges in rail tank cars until those cars are opened applies equally to the desulfurization filters before the Desulf Units are opened. Although both tank cars and Desulf Units can be and are moved, the hazardous wastes within both are contained in a sealed environment, posing minimal risk of accidental release. The moment that sludge in a tank car is removed, or the filter is taken from a Desulf Unit, is the moment when the potential for release comes into being and, hence, the moment when they become regulated as wastes under RCRA.

D. The Desulf Units Are Analogous to the Non-Exhaustive List of MPUs Referenced in the Federal Register Preamble, and Are Distinguishable From Disassembled Heat Exchangers.

Although the regulation itself does not further define an MPU, the Federal Register Preamble contains a non-exhaustive set of examples of MPUs. Most of these examples are associated

[18] Bloom Energy does not manufacture replacement Desulf Units—only Desulf Units needed for additional Energy Servers—and Bloom Energy does not maintain a large pool of spare Desulf Units.

with refineries and similar large-scale industrial operations that filed comments on the RCRA regulations when they were originally proposed. In addition to tanks storing material such as petroleum, the Preamble cites to

> [o]ther examples occur[ing] in a great many manufacturing processes, where hazardous wastes are generated in process units, such as distillation columns, flotation units, and discharge trays of screens and in associated non-waste-treatment process units such as cooling towers.

45 Fed. Reg. 72025.

Examples. The "other examples" provided by EPA are of equipment in which hazardous wastes reside for some period of time prior to removal of the hazardous waste. They reflect EPA's recognition that many manufacturing processes (such as flotation units and distillation columns—just like Desulf Units) include a step where needed materials are separated from unneeded or unwanted materials. EPA further recognizes that the hazardous materials created in the process, or through otherwise processing raw material, should not be regulated as hazardous wastes until the units are opened and their contents removed.

That Desulf Units used in fuel cells are not included among EPA's non-exhaustive examples of MPUs is neither surprising nor significant. EPA's examples derive largely from examples cited in comments it received from oil refiners and other major industry groups seeking to ensure that *their* MPUs would be exempt from regulation under hazardous waste laws. Applied fuel cell technology was generally still in its infancy in the late 70's and early 80's when EPA was writing the RCRA regulations, and the potential for Desulf Units to adsorb benzene from natural gas in connection with a fuel cell generating electricity would not have been on EPA's radar. If it had been, there is no reason to believe Desulf Units associated with fuel cells would not have been included as an example of an exempt MPU. There is no environmental policy rationale for reading EPA's examples as an attempt by EPA to categorize either Desulf Units or every MPU moved off site for cleaning as ineligible for the exemption.

Heat Exchangers. The DNREC staff has cited an EPA guidance document prepared in response to a question posed by phone to the RCRA hotline in 1990, which states that the MPU exemption does not apply to a heat exchanger disassembled for cleaning off site. RCRA Online #13374, May 1990, Enclosure 4. This document neither compels nor supports the proposition that an MPU must be stationary to qualify for the MPU exemption. Rather the document is fully consistent with EPA's view that *structural integrity* (not location) is the critical issue. For the reasons described above, the structural integrity of these Desulf Units exceeds that of most of the examples of MPUs provided by EPA, and bears no relation to heat exchangers.

In the 1990 guidance document, EPA analyzed whether the exemption applies when a refinery "disassembles" a heat exchanger within which sludge forms during the heat exchange process. EPA states that the exemption does not apply to an MPU *if the unit is disassembled for cleaning off-site*, for two reasons: (1) "the incentive to maintain the unit's integrity to prevent leaks or unintended releases is substantially reduced when the unit is taken out of operation;" and (2) "there would be a loss of the unit's structural integrity if it were to be disassembled for off-site shipment, with a potential for hazardous waste releases."

Bloom Energy is highly incentivized to maintain the Desulf Units' integrity. As explained above, Bloom has both compelling business and safety "incentive[s] to maintain the unit's integrity to prevent leaks or unintended releases" even after it is taken out of operation. Unlike a heat exchanger, which contains no valuable commodity either in-service or out of service, Bloom's Desulf Units contain the natural gas essential to their operation and must do so with no possibility of release. The Desulf Units contain valuable copper, which is generally reclaimed. And the Desulf Units are themselves valuable equipment—a value which would be largely nullified if the equipment's structural integrity were compromised, thereby making them unfit for reuse processing pressurized natural gas.

A heat exchanger is not a storage device that can safely contain materials when it is removed from the system shell, thereby posing the risk of dispersement of toxic substances during transportation. That is not at all the case for the Bloom Desulf Unit, as explained above.

The loss of the heat exchanger's structural integrity, upon disassembly, is irrelevant to Desulf Units. EPA's second stated reason for not applying the MPU exception to the heat exchanger described in its document—the loss of structural integrity if the heat exchanger is *disassembled*—is specific to heat exchangers. Bloom Energy *does not disassemble* Desulf Units. Rather, Bloom *removes sealed Desulf Units* and sends the Desulf Units *intact* to a transfer facility in Texas for removal of the filters and recovery of the copper. It is only when the Desulf Units are received at the transfer facility that they are opened, cleaned, and disassembled.

As can be seen in the images in Enclosure 5, Desulf Units and heat exchangers have very little in common.[19] Heat exchangers are sometimes cleaned on-site, and sometimes sent off-site for servicing. In the latter event, the heat exchangers are drained of most of their product contents and then left unsealed for shipment, allowing for leaks and releases. Heat exchangers are characterized by numerous openings in which pipes are inserted while they are in operation. When the heat exchangers are removed from operation, these pipes are

[19] Because EPA's files contained no information regarding the facts on heat exchangers considered by EPA when it issued the 1990 guidance document, Bloom Energy's counsel has engaged in detailed discussions with a company which has, for many years, been a leading provider of off-site servicing of heat exchangers, as well as with some of its clients.

removed, but the openings for the pipes remain open. Thus, simply removing a heat exchanger from service—regardless of whether it is further disassembled thereafter for off-site cleaning—creates the potential for leaks and releases. This is a critical risk point distinguishing Desulf Units from heat exchangers structurally. The Desulf Units have only three openings for the coupling hoses and these are automatically sealed shut when the gas lines are removed, and they remain sealed until the Units are opened for cleaning at an appropriate off-site facility.

E. Quite Apart From the MPU Exemption, EPA Has Since 1982 Viewed Residues Remaining in Gas Units When Returned by Customers as Being Excluded From the Definition of Solid Waste.

EPA itself has long considered residual gas in compressed gas containers not to be a waste. *See* 47 Fed. Reg. 36094 (August 18, 1982). The issue arose shortly after the final RCRA regulations were adopted in the context of questions about whether gas units (e.g., propane, oxygen, etc.) could be considered "empty" when shipped for refilling after customer use. EPA stated that the question was not whether the unit was empty, but rather whether the contents were a "waste:" "[T]he customer is not generating a waste by merely returning the cylinder and neither the returned container nor the contained residue is a 'solid waste' as that term is defined in [RCRA] and 40 CFR Part 261." EPA advised that the "return of the supplier's cylinder that may hold some residue does not constitute the shipment of a solid (or hazardous) waste." This fact scenario presents essentially the same issues as the management of Desulf Units, which contain a residue but are returned for refilling.

IV. Application of the MPU Exemption to the Desulf Units Produces Better Results for the Environment than Regulating Them as Hazardous Waste Upon Being Removed From Service.

Section I of this letter describes the environmental benefits of Bloom's technology. We do not repeat them here. However, it should be recognized that requiring the Desulf Units to be considered waste subject to RCRA simply because they have been removed from service may both create environmental/health risks which would otherwise be virtually non-existent, and limit the use of—and therefore the environmental benefits to be derived from—this technology.

A. Denying Application of the MPU Exemption to Desulf Units Taken out of Service Increases Risks.

As discussed above, Bloom Energy's analysis of Desulf Units at its four Delaware locations found that only one in four exceeded the RCRA limit for benzene. Given the small proportion of Units that exceed this limit, it would not be economically rational for Bloom to continue managing all of its Desulf Units in Delaware as hazardous waste from the moment

they are taken out of operation. This would effectively encourage Bloom to open every Unit at customer sites in order to perform a waste characterization. While it makes financial sense to do so, it does not make sense from an environmental point of view.

First, opening individual Units for characterization at each customer site would increase the number of people required to handle the contents of the Units. Not only is each of these individuals potentially exposed to the material, they also need to reach the site, increasing traffic and other associated inconveniences of having third-party workers at the sites.

Second, opening the Units for testing on-site increases the number of occasions those contents are handled and, therefore, the potential for emissions (even if these are below regulatory limits).

B. Denying the MPU Exemption Will Have Adverse Consequences for Delaware Businesses and for the Environment.

The alternative to opening the Desulf Units on-site is to manage all of the Desulf Units as hazardous wastes the moment they are removed from service. This would guarantee that a large proportion of *non-hazardous* waste would be managed as hazardous—a result directly contrary to EPA's waste minimization efforts.

Even more troubling is the impact on Bloom Energy's present and future customers. Every site at which a customer installs a Bloom Energy Server in support of its sustainability objectives would suddenly be transformed into a hazardous waste generation site the moment the Units are removed from service. An EPA Generator Identification Number would have to be issued for every school, government building, hospital, public library or other facility using Bloom Servers—whether for backup power or to meet their full energy demands—triggering potential requirements for permits, facility self-inspections, recordkeeping and reporting, contingency planning and the like. Even where the cost or obligation to implement these requirements can be assumed by Bloom, the designation as a hazardous waste generation site is tied very directly and explicitly to the customer. For energy users like schools, public buildings, or clean businesses that may generate no other hazardous waste, often as a result of programs they put in place to achieve that very goal, such a designation has a host of negative implications which are likely to result in a significant disincentive to their adoption of this clean technology. The unintended consequence, clearly, will be to slow down the rate of CO_2 reduction attributed to power generation—plainly a result neither Delaware nor EPA wants.

C. There Are No Offsetting Environmental Benefits to Requiring that Desulf Units Be Managed as RCRA Wastes Before They Are Opened.

One of the primary issues raised by DNREC staff at the January meeting was whether, without a requirement to manage the Desulf Units' contents as hazardous from the moment of removal from service, there would be increased risks in transit. As demonstrated above, there are no such real risks. The only appreciable difference in the transportation of Units if the MPU exemption does not apply, is that the Units' contents will be accompanied by one form of paper—a manifest—from the time the Units are removed from service. Under the MPU exemption, the Units' contents would travel under a different form of shipping paper prior to the point of waste generation at the facility that opens the Units, at which point the contents would be manifested. It is difficult to see the benefit achieved by imposing a manifest requirement at an earlier stage, given that Bloom's management and handling of the Units would be virtually identical. Either way, no Desulf Units will go missing.

Nor is there any difference in the risks posed in transit. As explained in detail elsewhere in this letter, the Desulf Units themselves are every bit as secure—likely more so—than containers used by hazardous waste transporters. Finally, the reality is that the Units' contents pose very low risks, if any, to the environment, whether in a sealed or opened container. The benzene which brings them within the definition of "hazardous" is present solely because it is adsorbed onto the Units' filters. This adsorbed benzene can only be released (such that it could pose a potential risk of actual harm) if the filters are heated to temperatures exceeding 180 degrees Celsius (356° F). So, no environmental risks can occur unless the Unit—which is carefully sealed and subjected to multiple pressure tests upon closure, requires training and specialized equipment to open, and has structural integrity equivalent to hazardous waste transportation packaging—is first opened and then heated to an extremely high temperature. Such an improbable scenario is far less likely than human or environmental contact with a rail car left unattended on a siding, or a product tank removed from service.

V. Conclusion

Bloom Energy provides electric power with a dramatically reduced environmental footprint as compared to traditional energy sources. In doing so it has made every effort to comply rigorously with all environmental requirements. This is true, as well, of its management of the Desulf Units which are an integral part of its energy production process.[20]

[20] Bloom Energy takes pride that, in its seven years in operation, it has never received a notice of violation from any environmental agency or prosecutor, whether in Delaware or elsewhere.

Bloom's Desulf Units fit squarely within the MPU exemption in both RCRA and Delaware law:[21] the Units satisfy the literal regulatory language of the exemption; they are analogous to examples of MPUs provided by EPA; and application of the MPU exemption to the Desulf Units is entirely in keeping with the intent and the rationale for the exemption. As such, the Desulf Units are exempt from regulation until no sooner than the time they are opened for cleaning.

Neither EPA nor any State has ever concluded that Desulf Units must be managed as hazardous wastes before they are opened. Nor would there be any environmental benefit to doing so. There is no realistic prospect that the benzene in the small proportion of Desulf Units that test RCRA hazardous will be released before the Units are intentionally opened by authorized personnel. As evidenced by, among other things, the fact that these Units pass DOT testing requirements for metal containers used to ship hazardous materials, they have structural integrity equivalent to containers that would be used if they were shipped under a manifest. Moreover, the benzene inside the Units is adsorbed onto filter material and could not pose a risk without being heated to high temperatures.

The reality is that insisting that these Desulf Units be regulated simply because they are taken out of service will have an adverse impact on the environment. It would force Bloom to have the Desulf Units opened on site to determine whether or not the contents exceed RCRA limits, thereby increasing the potential for exposure to people within the State of Delaware, a population that would otherwise never be exposed to benzene in the Units. It would also require a RCRA Identification number for every site in Delaware at which there are Bloom Servers. The net effect would be to brand Delaware companies which have improved the environment by using this alternate technology, as sites of hazardous waste generation. This does not serve the purposes of RCRA, or Delaware law, or the environment. Denying application of the exemption could disadvantage Delaware

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[21] As a separate matter, Bloom Energy believes that reclamation of copper from the filters exempts the filters from the requirement to manage them as hazardous wastes under 40 CFR 261.1(a) and Delaware Hazardous Waste Regulations Section 261.1(a). Reclamation removes certain materials from the definition of solid waste. 40 CFR 261.2(c) (3); Delaware Regulations Section 261.2(c) (3).

> A material is "reclaimed" if it is processed to recover a usable product, or if it is regenerated. Examples are recovery of lead values from spent batteries....

40 CFR 261.1(c) (4); Delaware Regulations Section 261.1(c) (4). Bloom Energy's reclamation of copper from the filters is similar to the reclamation of lead from batteries.

We have not provided a detailed analysis of this further exemption inasmuch as this letter is addressed to the application of the MPU exemption, which we believe is fully justified on the facts presented. But we would be pleased to provide further details on this reclamation exception should DNREC wish to receive them.

companies that use Bloom's clean technology as compared to their counterparts in states which do not interpret the law the same way; it would also disadvantage those Delaware companies that get their electricity from Bloom's clean technology, as compared to those whose energy sources pollute the planet. We are confident that this is not the result DNREC desires, nor is it a result compelled by law.

Thank you for permitting us the opportunity to present Bloom Energy's position in writing. Bloom looks forward to continuing its strong working relationship with DNREC and its staff and is available to discuss the contents of this letter with you if that would be of assistance.

Very truly yours,

Michèle B. Corash
Counsel to Bloom Energy

Enclosures

cc: Kara Coats (Via Fed Ex)
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June 3, 2015

Michele B. Corash
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Dear Ms. Corash:

This letter responds to yours dated March 12, 2015 concerning Bloom Energy's desulfurization canister units (Desulf Units). I appreciate the information that you supplied as a follow-up to our discussion earlier this year.

I also appreciate Bloom's provisional accommodation in using hazardous waste protocols in handling the Desulf Units in the interim while we reviewed whether the Desulf Units fall within the manufacturing process unit exemption in Delaware's *Regulations Governing Hazardous Waste* § 261.4(c). [1]

The manufacturing process unit exemption is as follows: A hazardous waste which is generated in a manufacturing process unit is not subject to regulation as a hazardous waste until it exits the unit in which it was generated unless the hazardous waste remains in the unit more than 90 days after the unit ceases to be operated for manufacturing.

The rationale for the exemption is that manufacturing process units are designed and operated to hold valuable products or raw materials during manufacturing. "Because of their design and operation, these units are capable of holding, and are typically operated to hold, hazardous wastes which are generated in them, until the wastes are purposefully removed. Thus, these hazardous wastes are contained against release to the environment (except of course when abnormal circumstances such as fire or explosion occur) and the risks they pose to human health

[1] 7 *Del. Admin. C.* § 1302. This exemption is identical to the corresponding exemption in 40 CFR 261.4(c).

or the environment are very low and are only incidental to the risks posed by the valuable product or raw material with which they are associated."[2]

Based on Bloom's representations, and the information known to me as of the date of this letter, I conclude that the Desulf Units fall within the manufacturing process unit exception.

Under Delaware's Coastal Zone Act and regulations, the generation of electricity is considered to be manufacturing. The installation of 30MW of generation from Bloom's Servers at the Red Lion Energy Center near Delaware City required a Coastal Zone permit as a manufacturing activity. I am not aware of any binding or persuasive authority to the contrary in the present context. Accordingly, the Desulf Units are involved in manufacturing within the meaning of the exemption.

The robust structural integrity of the Desulf Units (which are made to be reused for as long as 15 years), and the low levels of benzene contained in the Desulf Units, are of particular significance, as is the representation that not all of the Desulf Units contain levels of benzene that would trigger RCRA requirements as hazardous waste.

Accordingly, any hazardous wastes in the Desulf Units are contained against release to the environment and the risks they pose to human health or the environment are very low and are only incidental to the risks posed by the valuable product or raw material with which they are associated. The Desulf Units, and the circumstances surrounding them, fall within the rationale for the manufacturing process unit exemption.

You have acknowledged the 90-day limitation in the manufacturing process unit exemption and I appreciate your indication that as applied to the present circumstances, the process of servicing the Desulf Units takes days not months.

While any wastes in the Desulf Units are not considered hazardous by Delaware until the Units are opened, EPA guidance suggests that the Units are still considered to contain solid wastes.

"Manufacturing process units often hold materials which can be classified as solid wastes and potentially hazardous wastes (e.g. precipitated residues). Even though these materials are exempt from hazardous waste regulation under Section 261.4(c), they are still considered solid wastes, thereby rendering the manufacturing process unit a Solid Waste Management Unit."

As such, I believe that the Desulf Units should be collected and transported by a permitted Delaware Solid Waste Transporter pursuant to 7 Del. Administrative Code § 1301 –

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[2] 45 F.R. 72025

7.0. In addition, should any facility in Delaware become a centralized collection point for Desulf Units, the location would likely be considered a Transfer Station subject to permitting and regulatory requirements under 7 Del. Administrative Code § 1301 – 10.0 However, I recognize that your letter did not provide a detailed analysis on certain aspects of the issue of solid waste and you offered to provide further details. If you have additional information we can review it.

I expect that there will be additional conversations between Bloom and EPA to seek clarification on this matter given that Bloom has Energy Servers in service in multiple states and EPA Regions. We look forward to further guidance that may result from those communications.

Sincerely,

David S. Small
Secretary

cc: David L. Ormond, Jr.
Deputy Attorney General
Delaware Department of Justice